An Investigation of the effects of Fall Turnover of Iron Gate Reservoir on Iron Gate Dam Release Water Quality

By

U.S. Fish and Wildlife Service

Arcata Fish and Wildlife Office

Acknowledgements

- Field support - FWS/NCRWQCB
- Financial Support for Laboratory Analyses
  - Karuk Tribe
  - Yurok Tribe
  - Hoopa Tribe
  - Resighini Tribe
  - Quartz Valley Tribe

Study Objective

- Determine the timing and effect of Fall turnover of Iron Gate Reservoir on the water quality of Iron Gate Reservoir and the Klamath River below
- Monitor water quality conditions above, below and at different depths within Iron Gate Reservoir during the late Fall
- Identify changes in nutrient concentration and monitor general water quality conditions at the study sites
- Differentiate between water quality conditions resulting from the turnover event and those due to upstream influences.

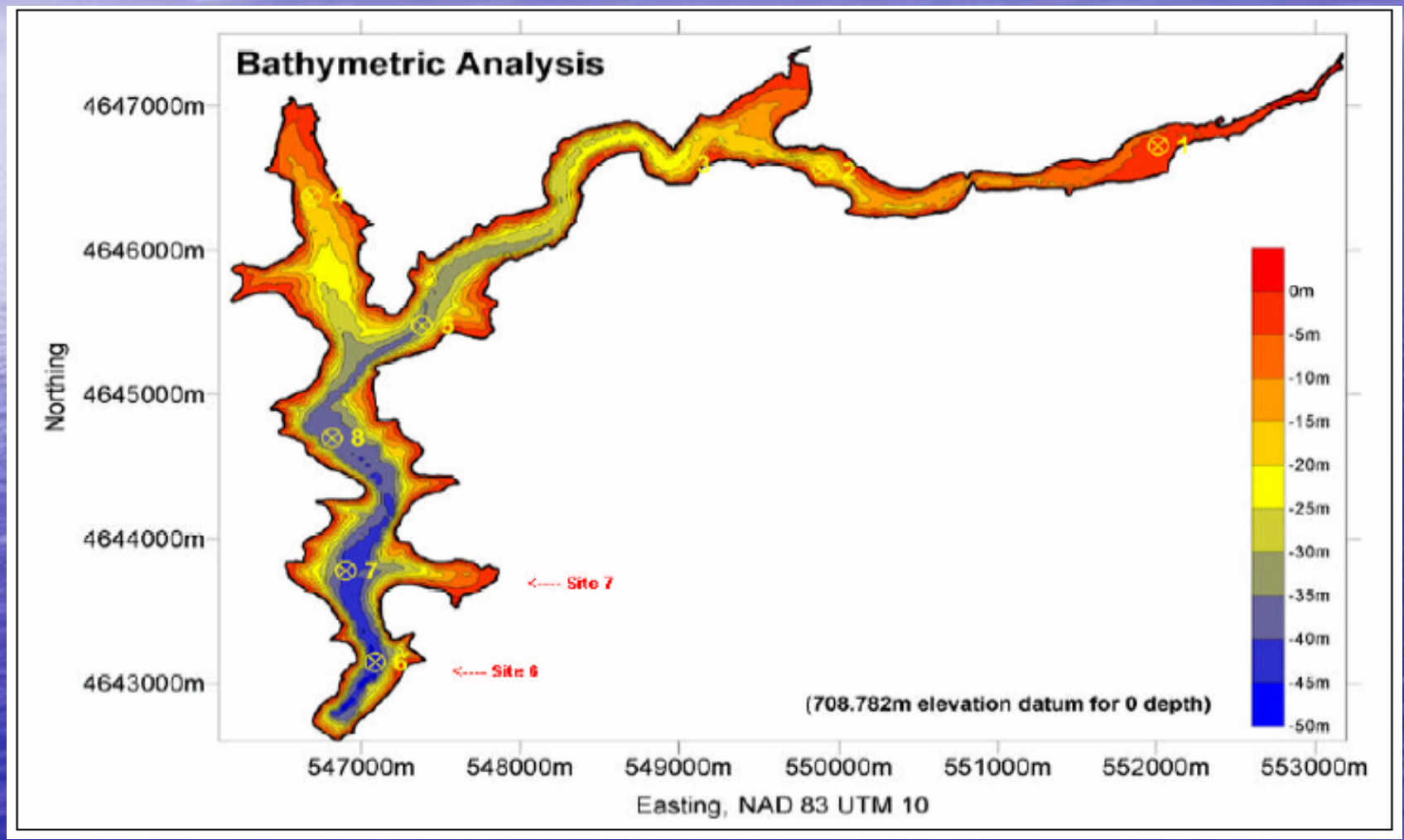
Study Design

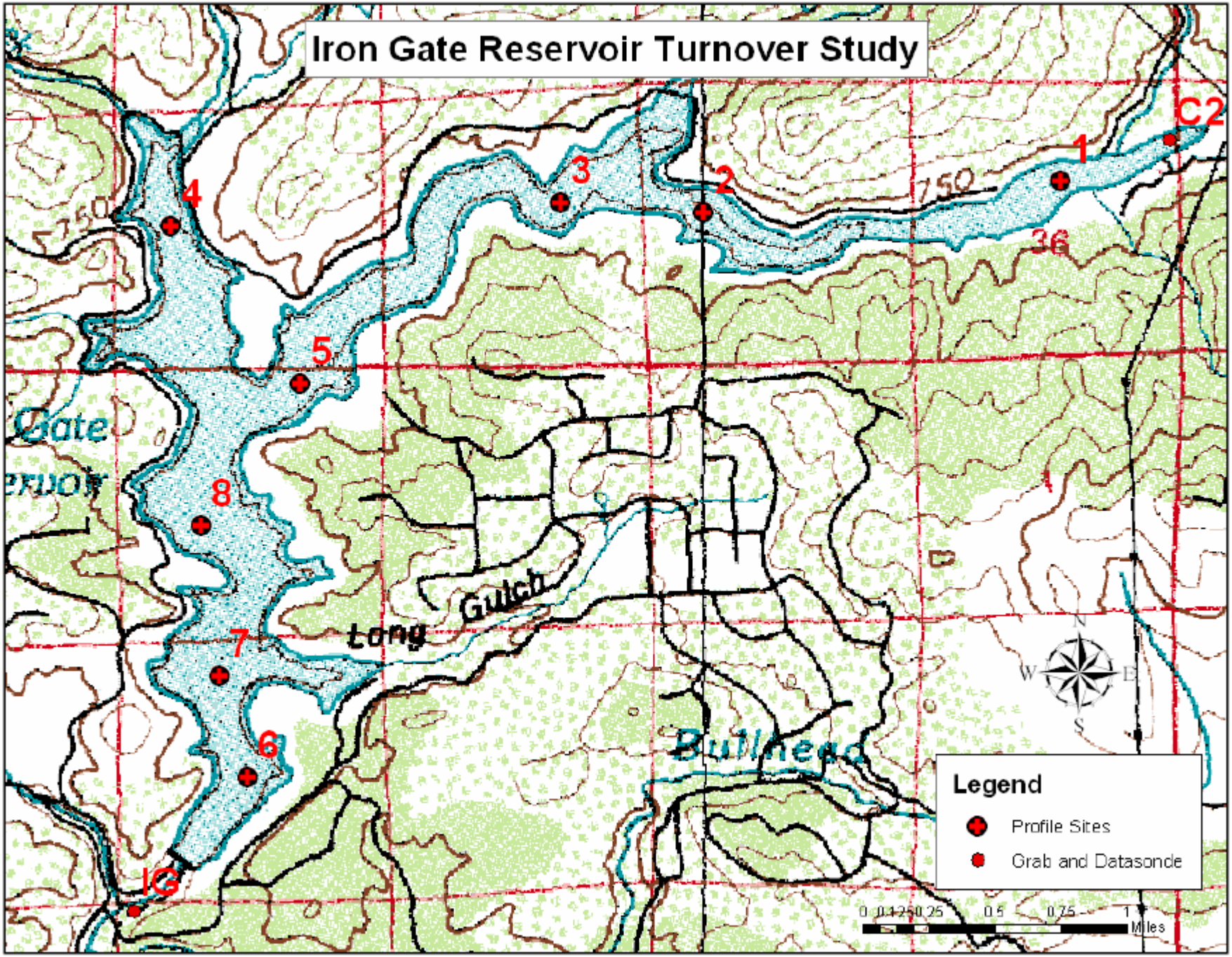
- Above the reservoir
  - Below the Copco II powerhouse
- Continuously monitored water temp, specific conductance, pH and dissolved oxygen concentration
- Sampled nutrients weekly (October 20 to December 7)

Study Design

- Five locations within Iron Gate Reservoir
  - Historic PacifiCorp Sites
- Vertical Profiles every 5 feet for water temp, specific conductance, pH and dissolved oxygen concentration
- Sampled nutrients twice within the epilimnion and hypolimnion.

Iron Gate Reservoir
5 sites for vertical profiling




Iron Gate Reservoir Turnover Study
C2
1
2
3
4
5
6
7
8
IG
36
750
750
Gate
Long Gulch
Bullhead
N
W
E
S
Legend
Profile Sites
Grab and Datasonde
0 0.125 0.25 0.5 0.75 1
Miles

Study Design

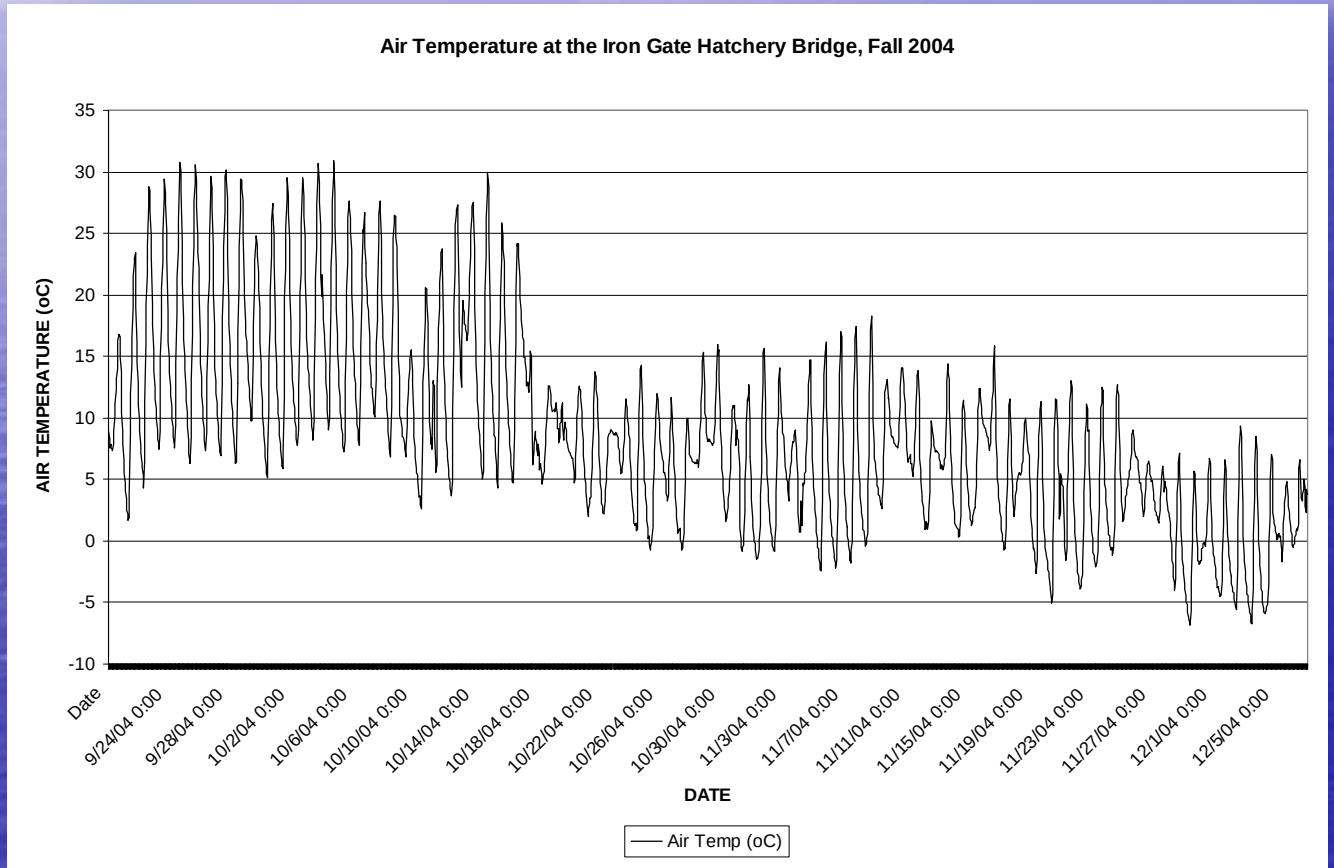
- Downstream of the reservoir
  - Iron Gate Hatchery Bridge (IG)
  - Klamath R. above the Shasta (K1)
- Continuously monitored water temp, specific conductance, pH and dissolved oxygen concentration
- Weekly nutrient samples and continuously monitored air temp and relative humidity at Iron Gate only

Study Period- Oct 20th to Dec 6th

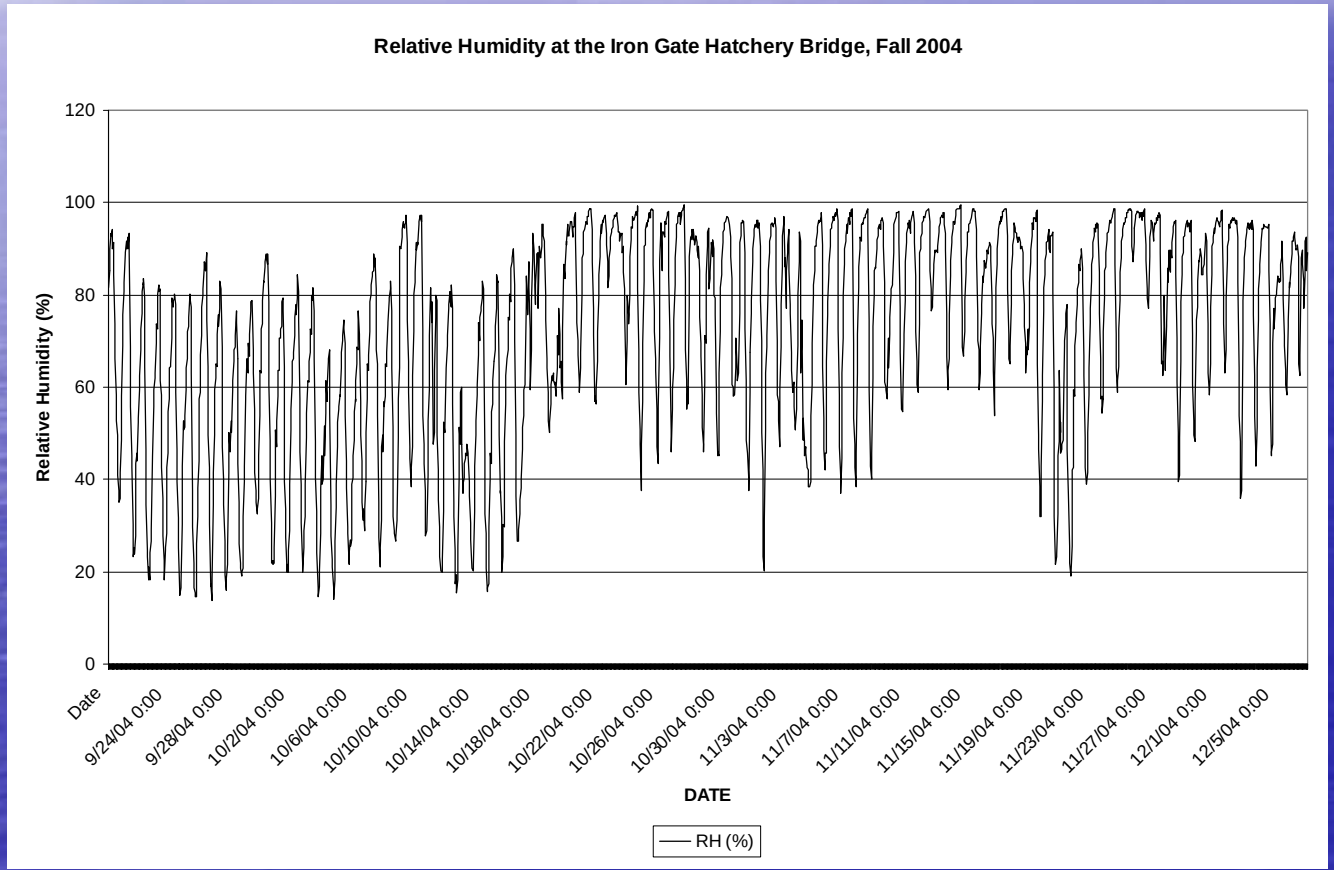
- Air Temperature/RH probe at IG and DataSondes at IG and K1 operated continuously before the study began through December 6th.

- Data from these probes presented for the month leading up to the start of the study on October 20th to help define conditions prior to the turnover event.

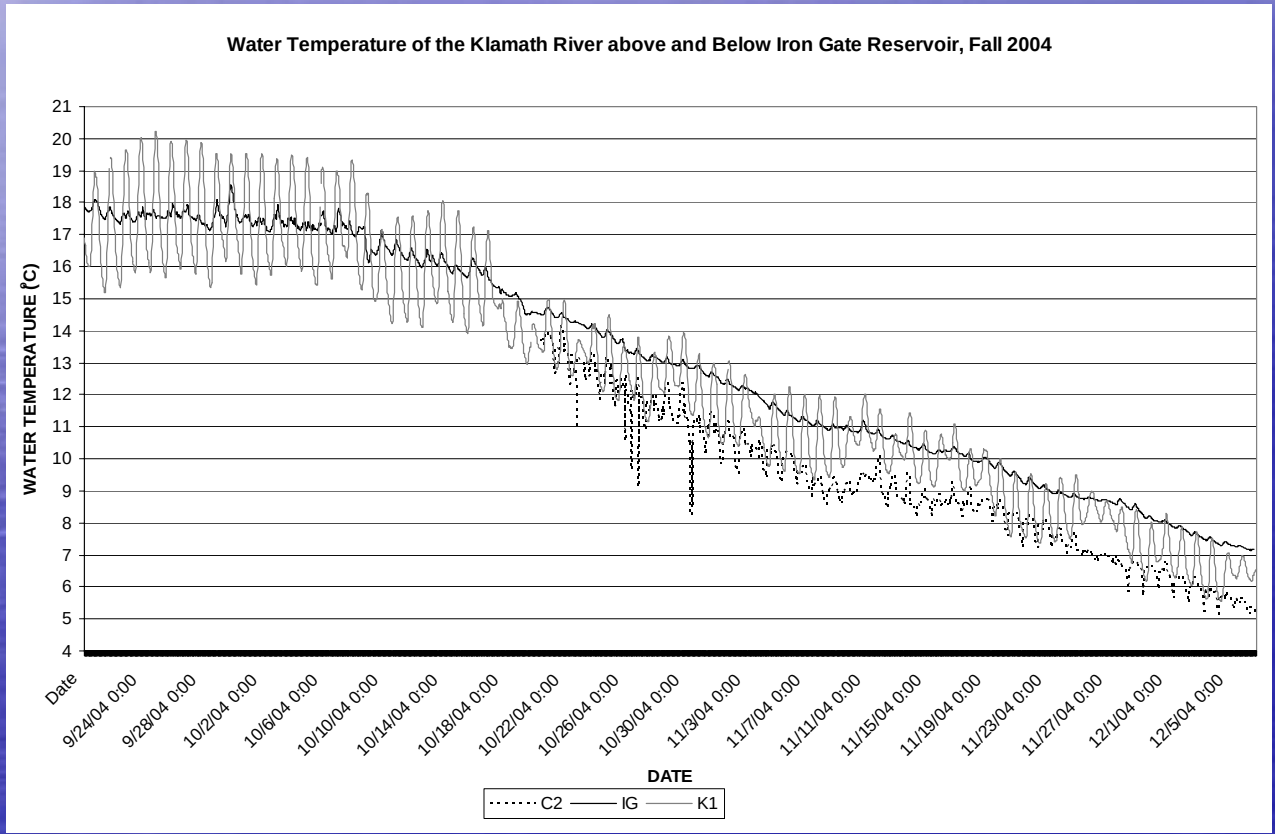
Air Temperature at the Iron Gate Hatchery Bridge, Fall 2004



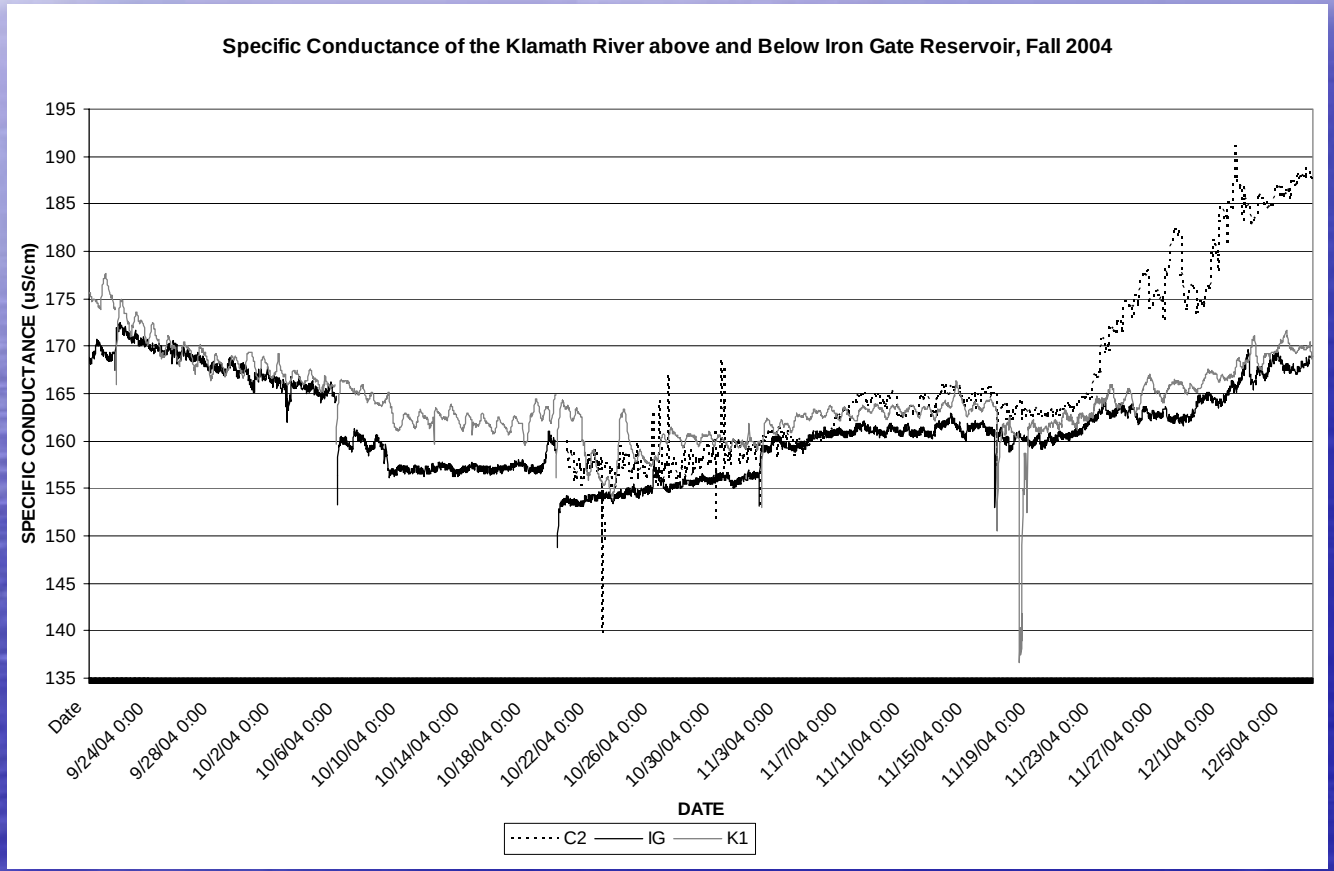
Relative Humidity at the Iron Gate Hatchery Bridge, Fall 2004



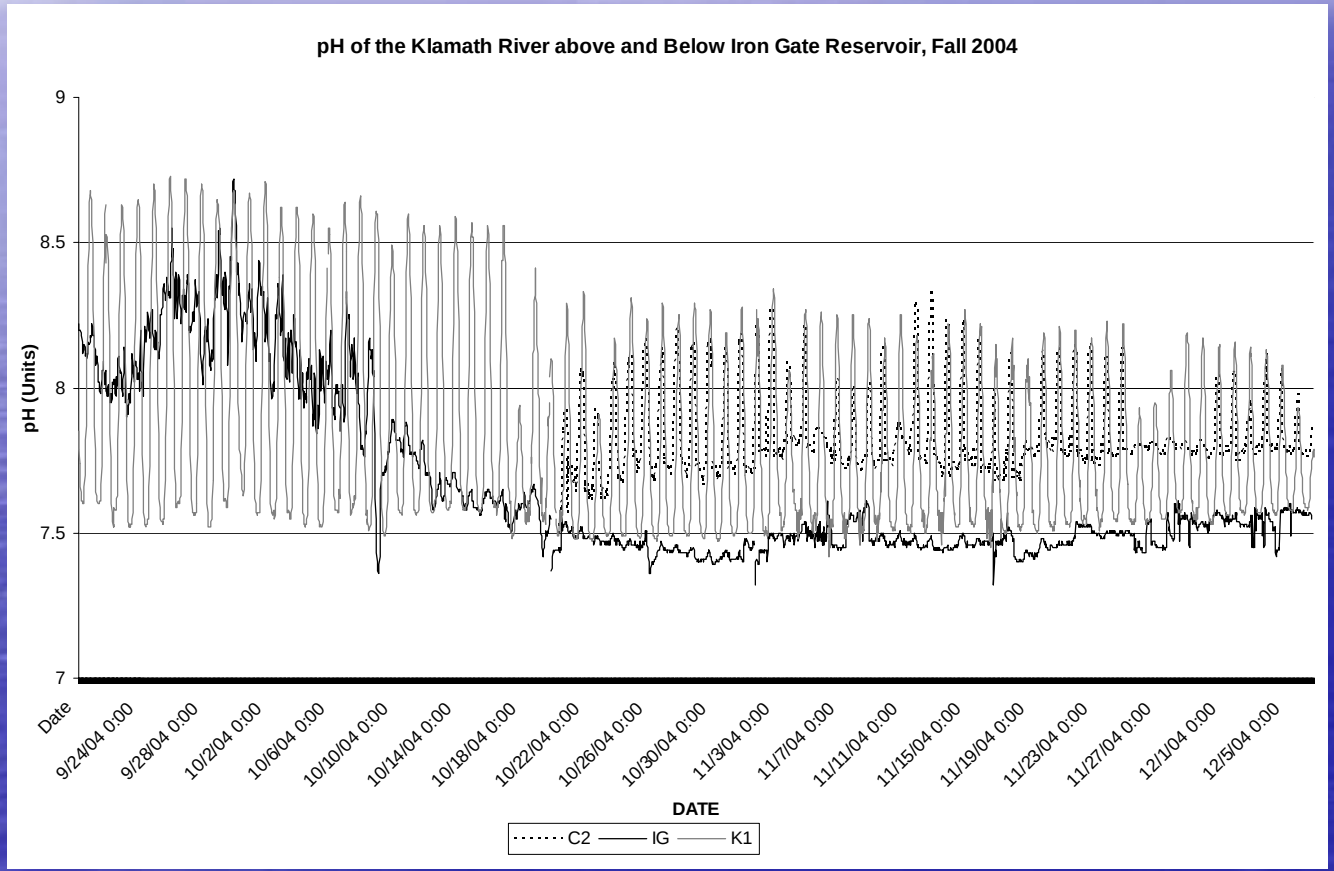
Water temperature above and below the Iron Gate Reservoir, Fall 2004



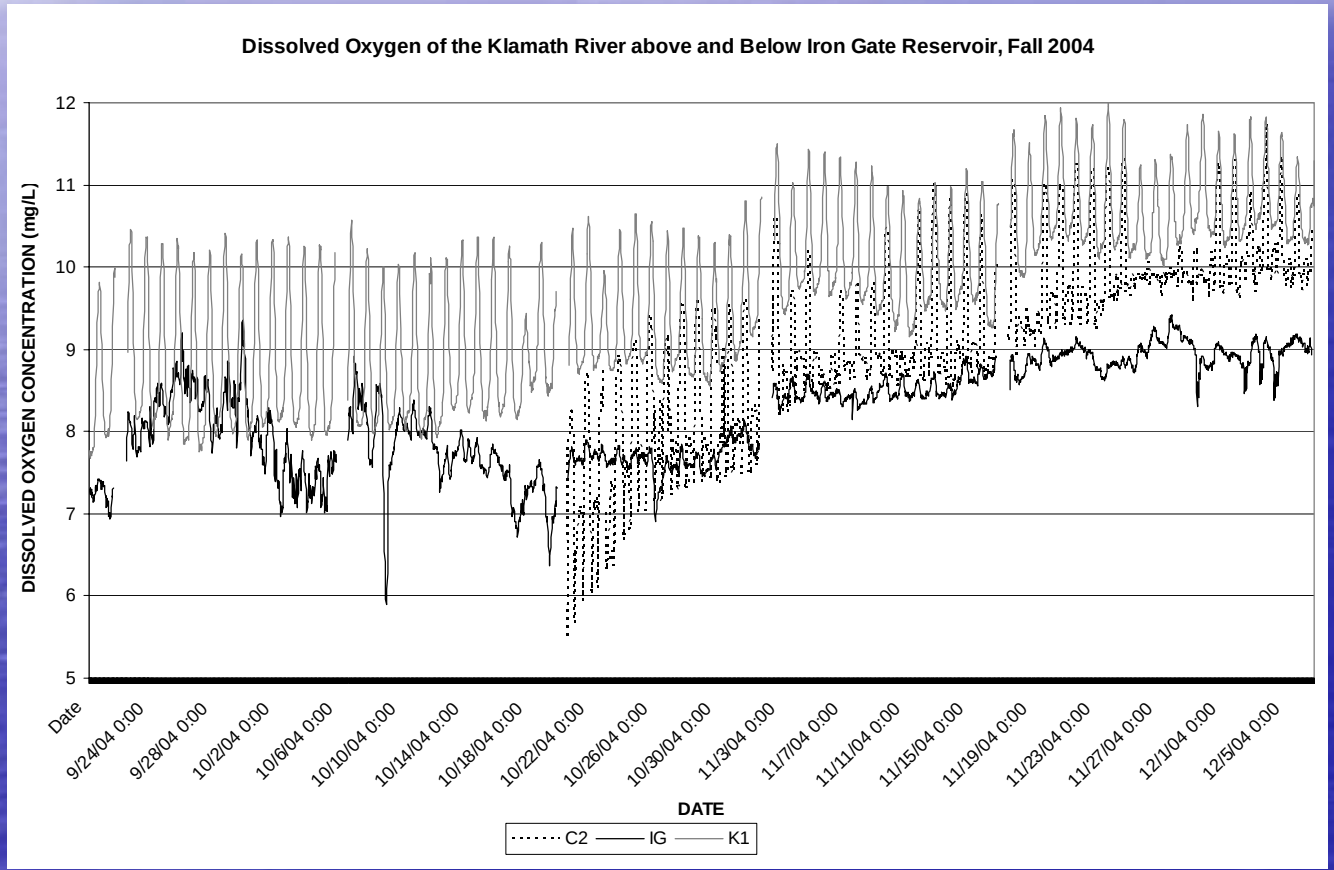
Specific conductance above and below the Iron Gate Reservoir, Fall 2004



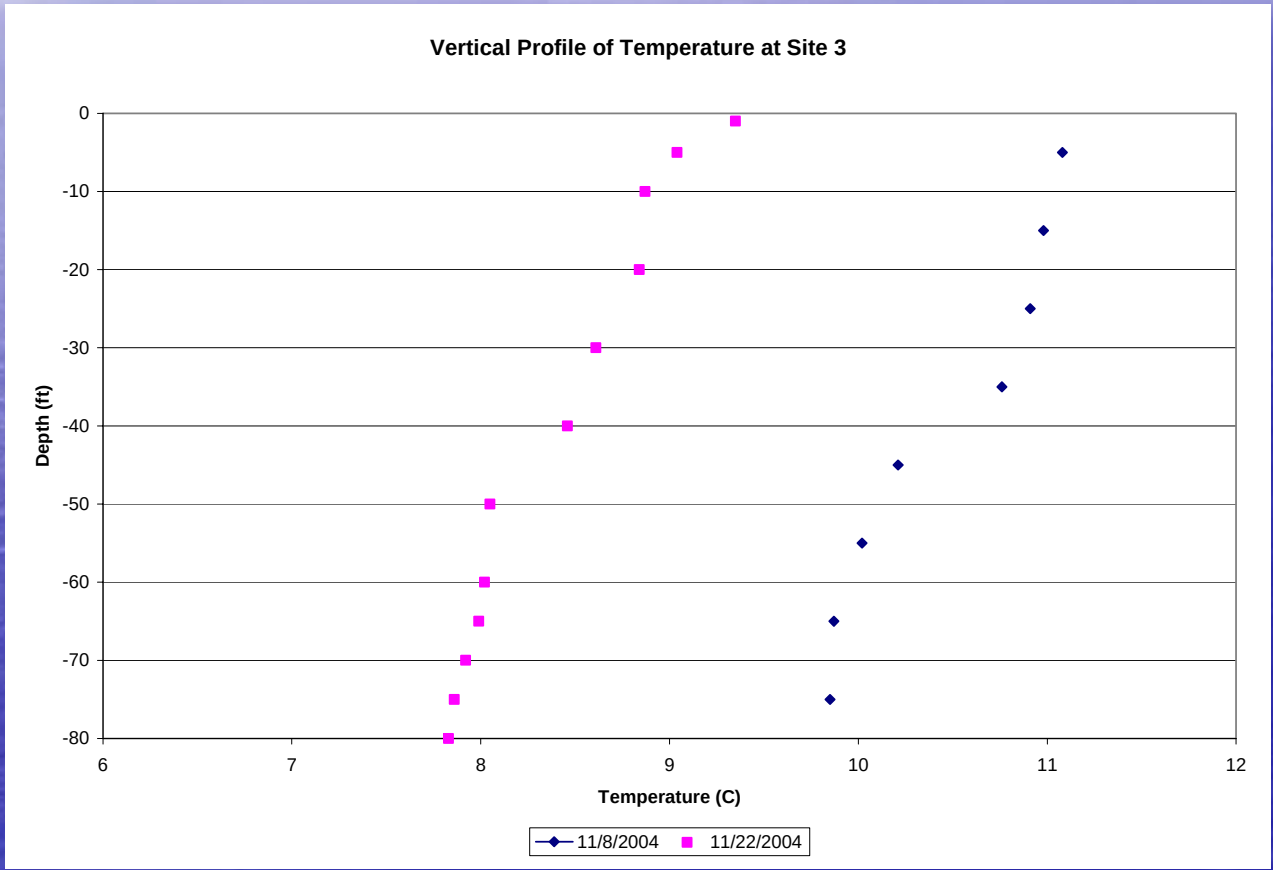
pH above and below the Iron Gate Reservoir, Fall 2004



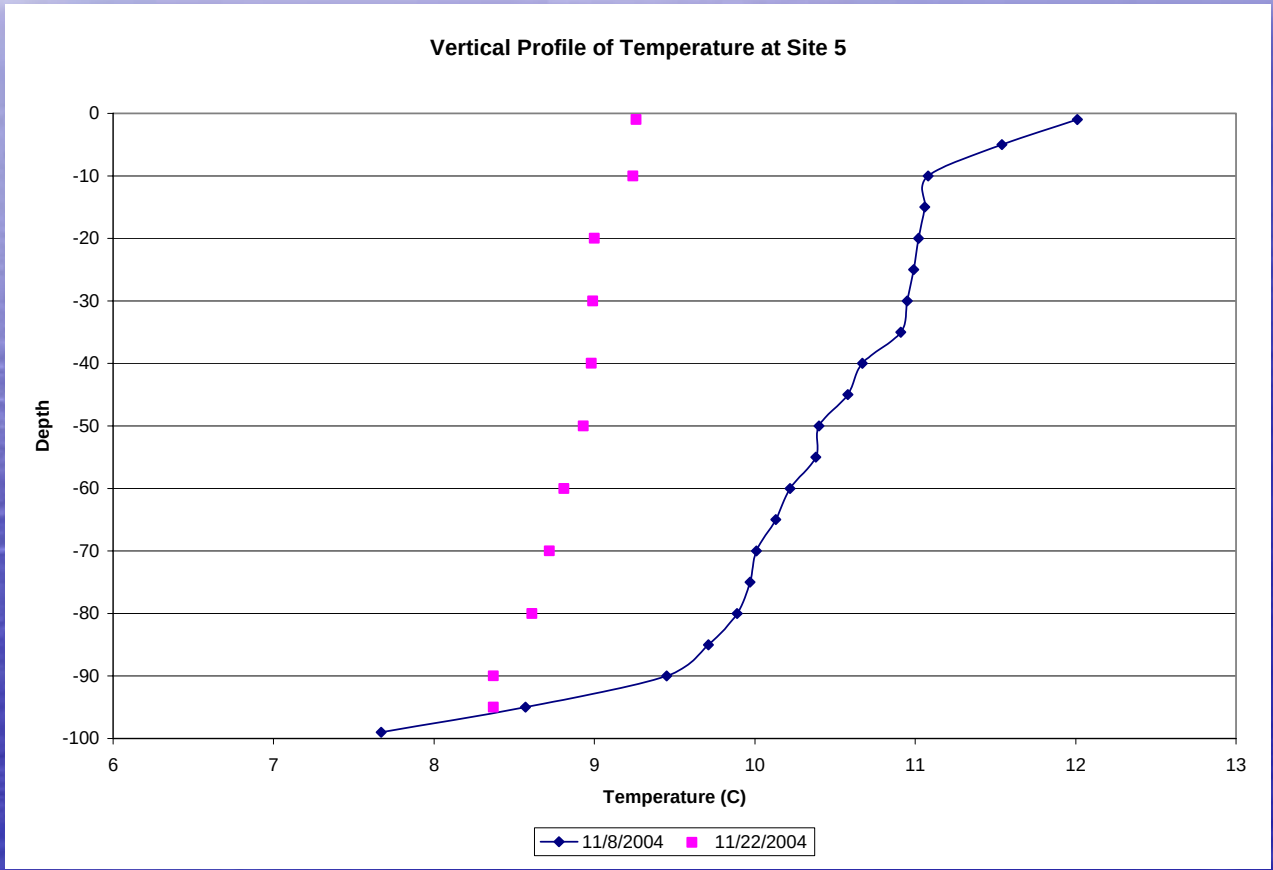
Dissolved Oxygen above and below the Iron Gate Reservoir, Fall 2004



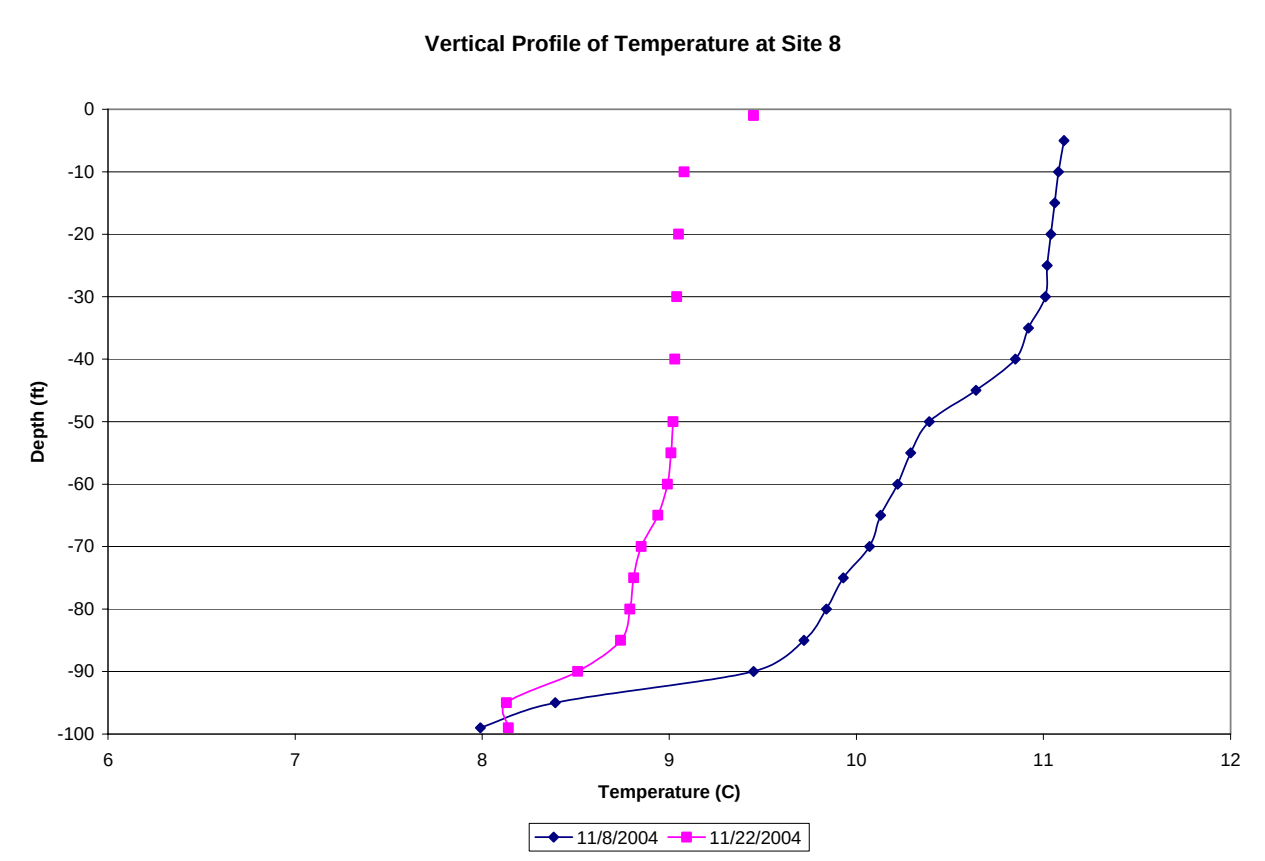
Vertical Profile of Temperature at Site 3, Fall 2004



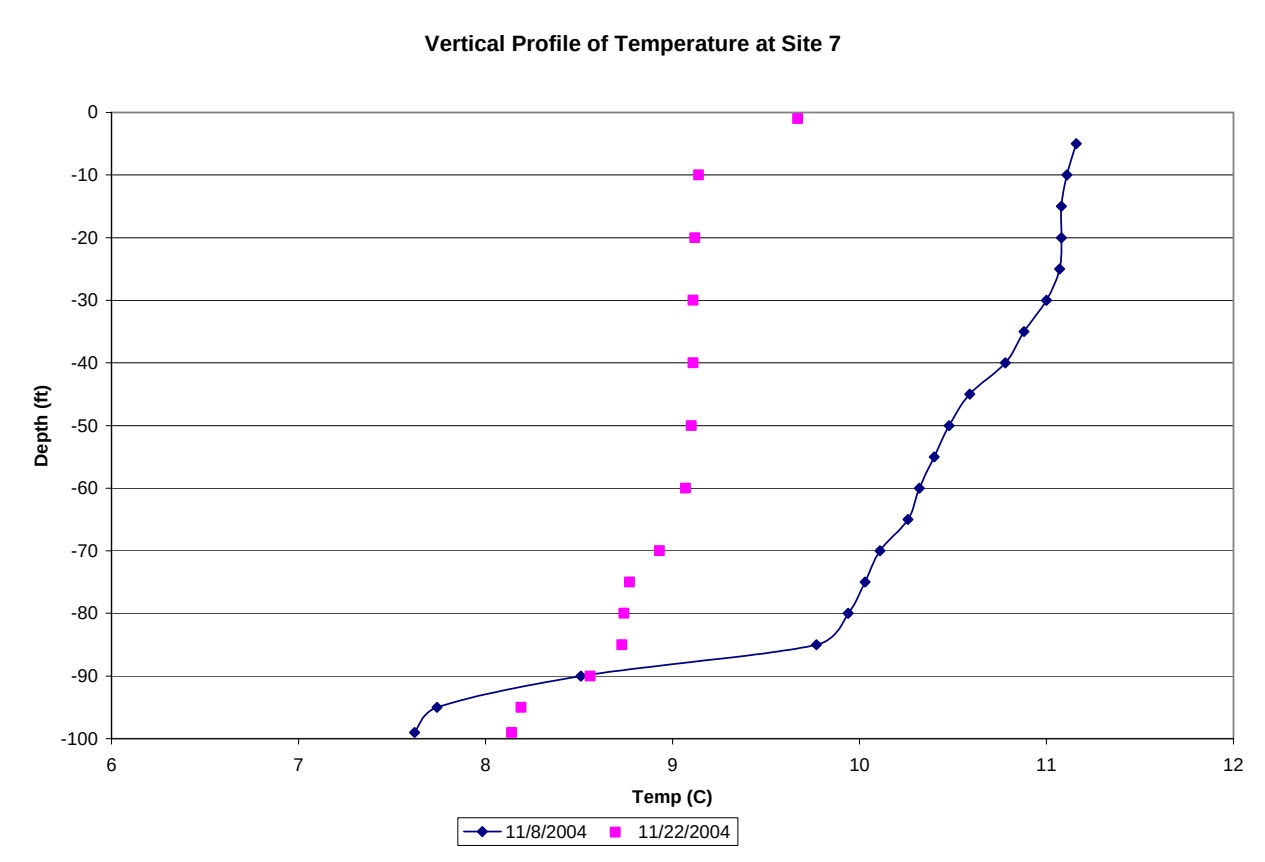
Vertical Profile of Temperature at Site 5, Fall 2004



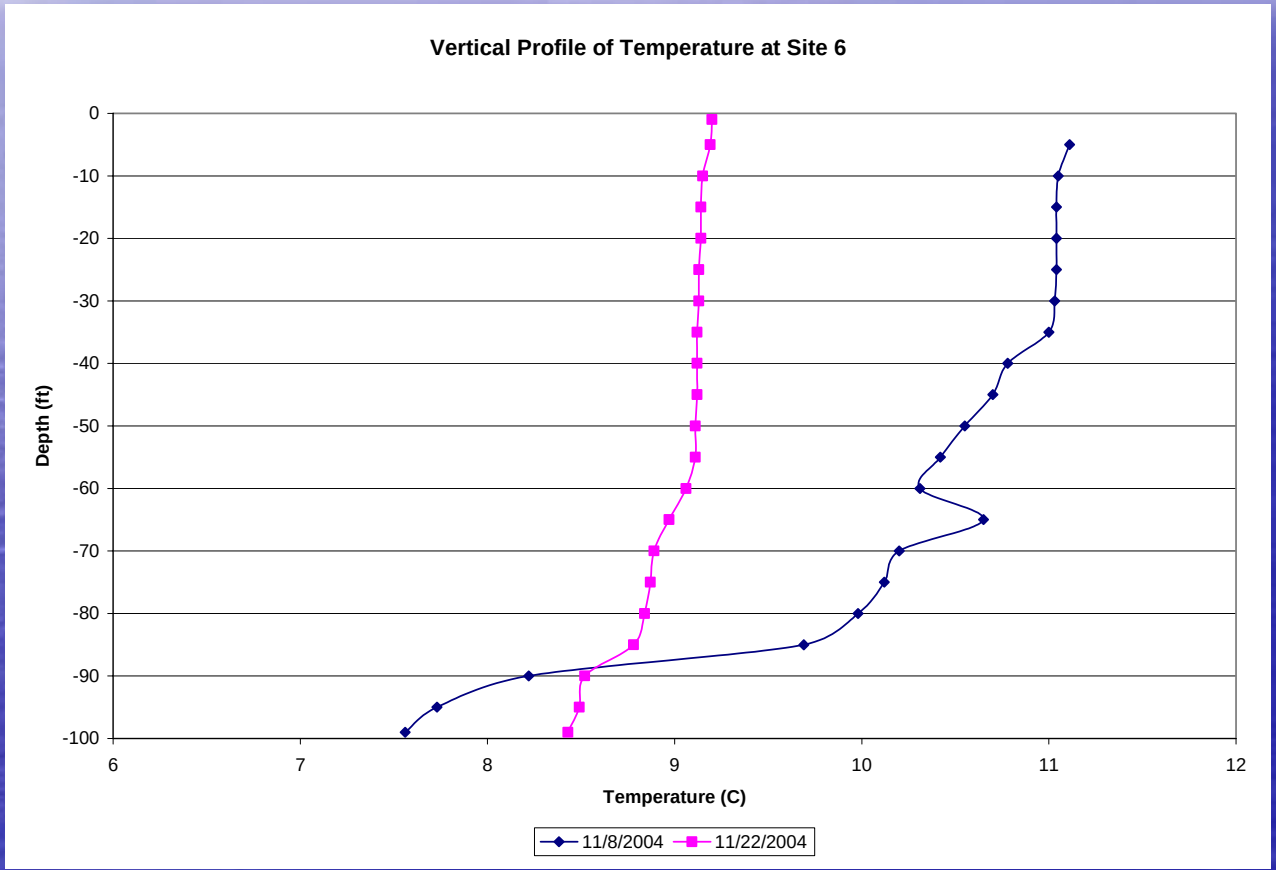
Vertical Profile of Temperature at Site 8, Fall 2004



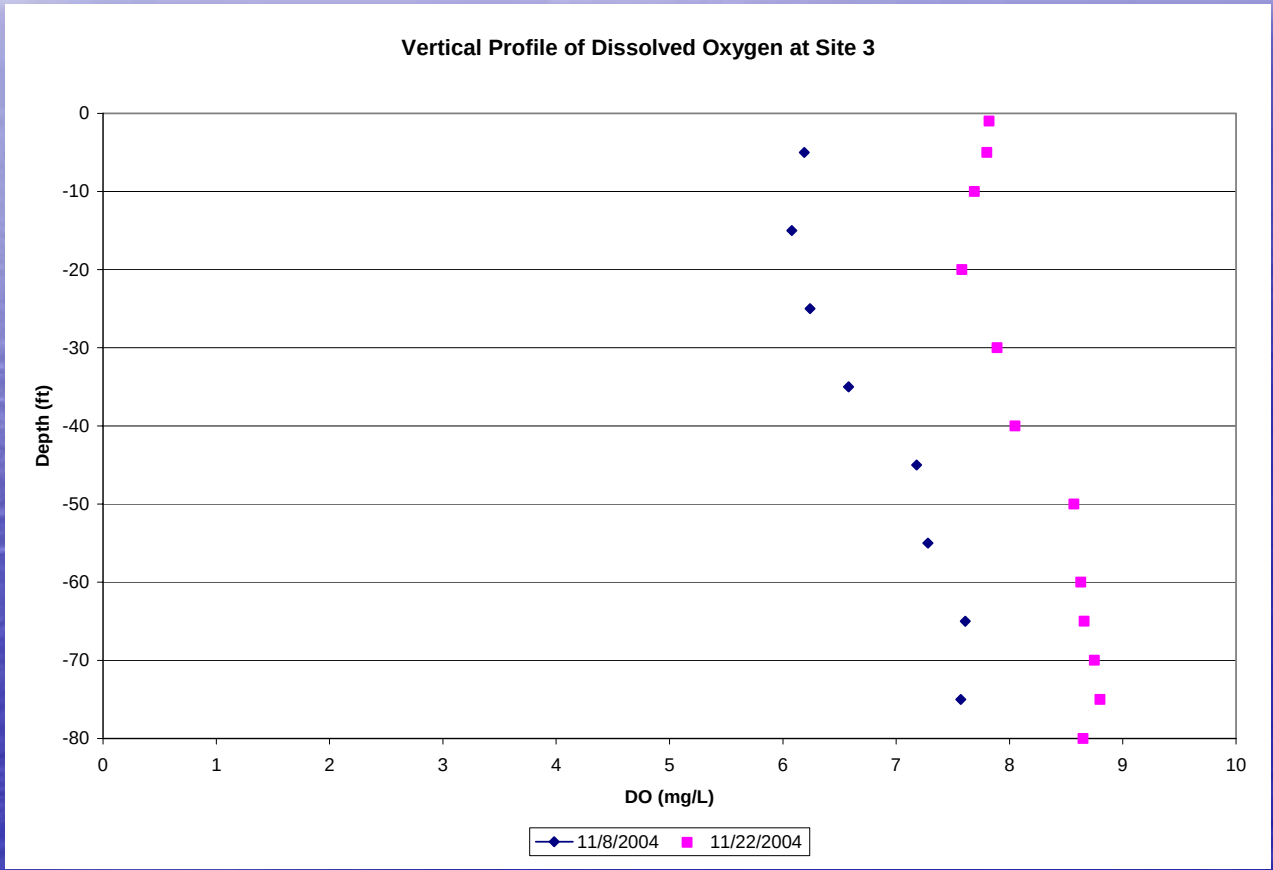
Vertical Profile of Temperature at Site 7, Fall 2004



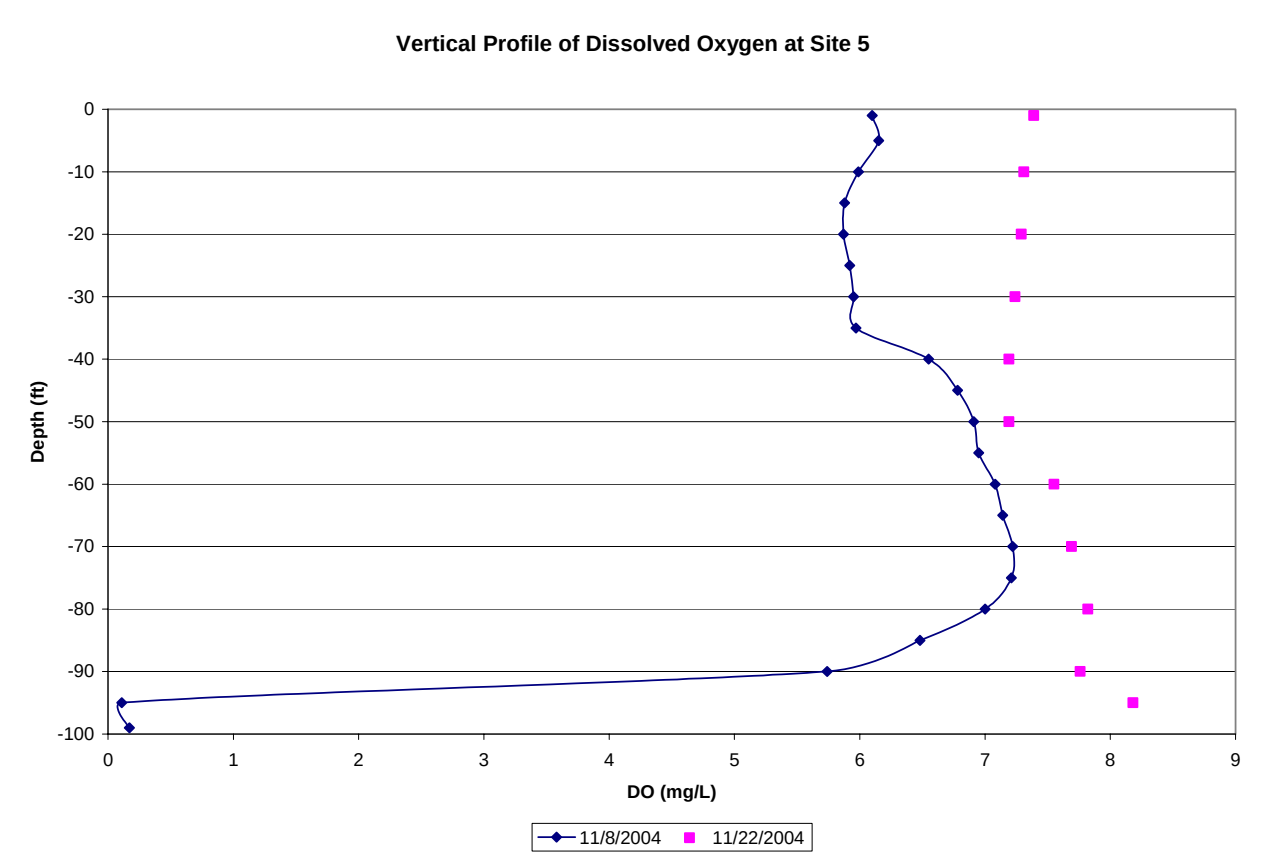
Vertical Profile of Temperature at Site 6, Fall 2004



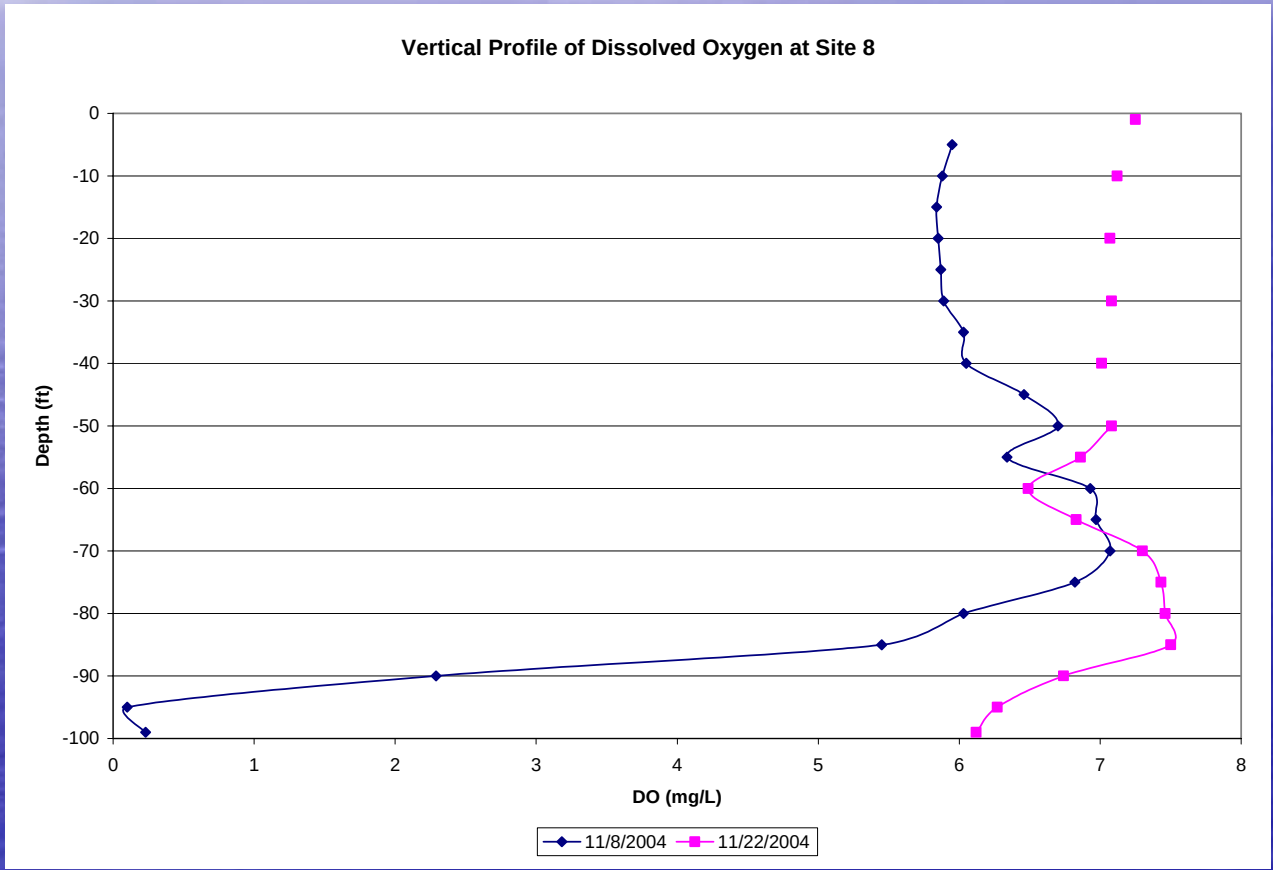
Vertical Profile of Dissolved Oxygen at Site 3, Fall 2004



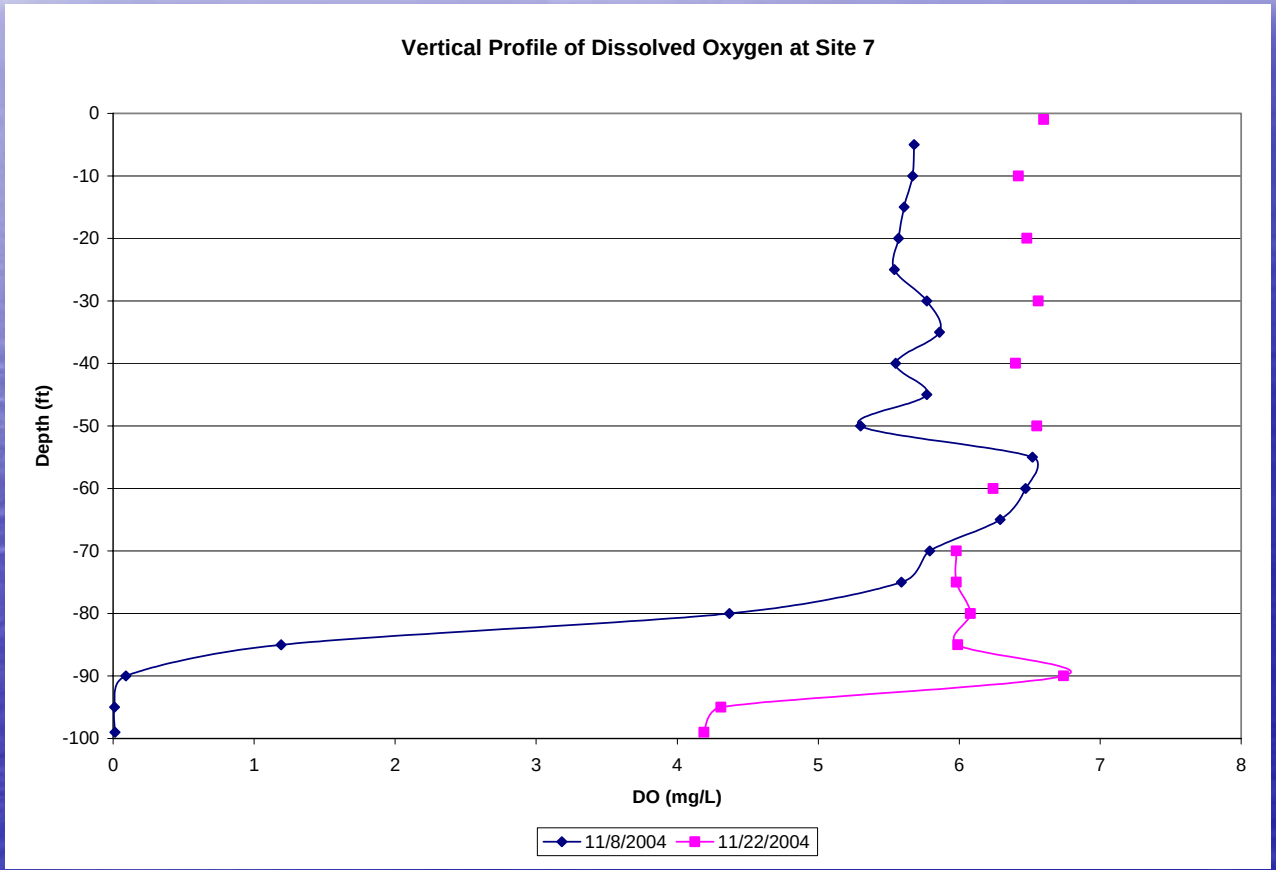
Vertical Profile of Dissolved Oxygen at Site 5, Fall 2004



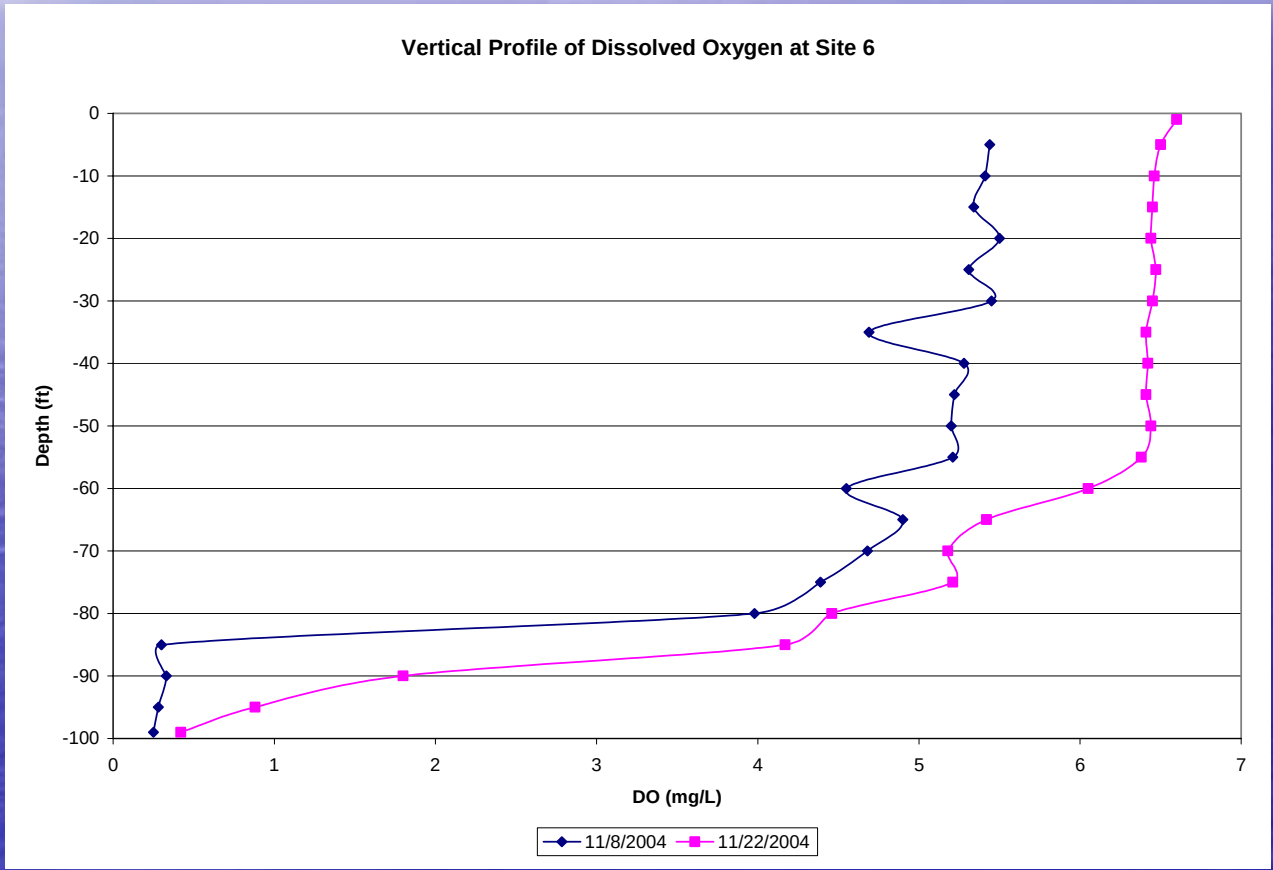
Vertical Profile of Dissolved Oxygen at Site 8, Fall 2004



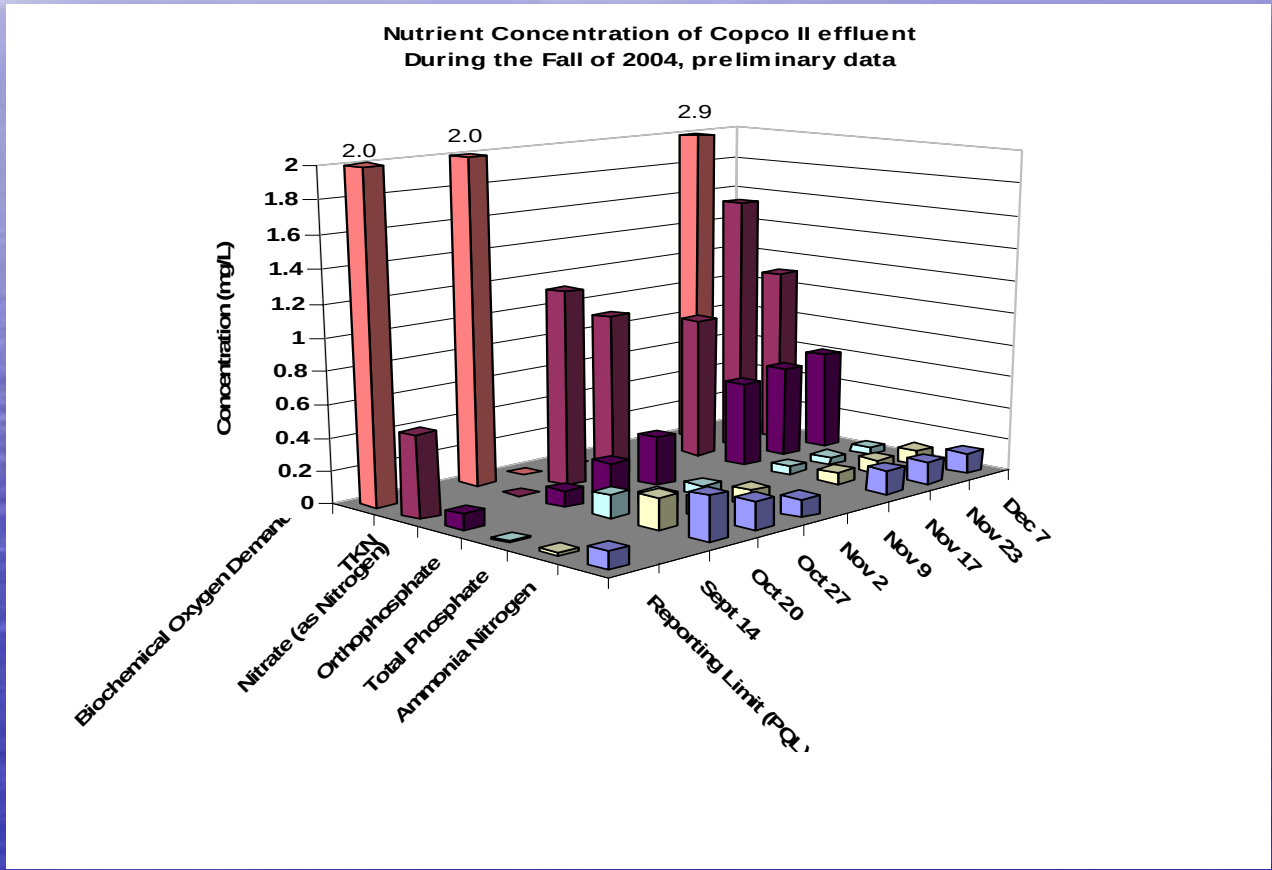
Vertical Profile of Dissolved Oxygen at Site 7, Fall 2004



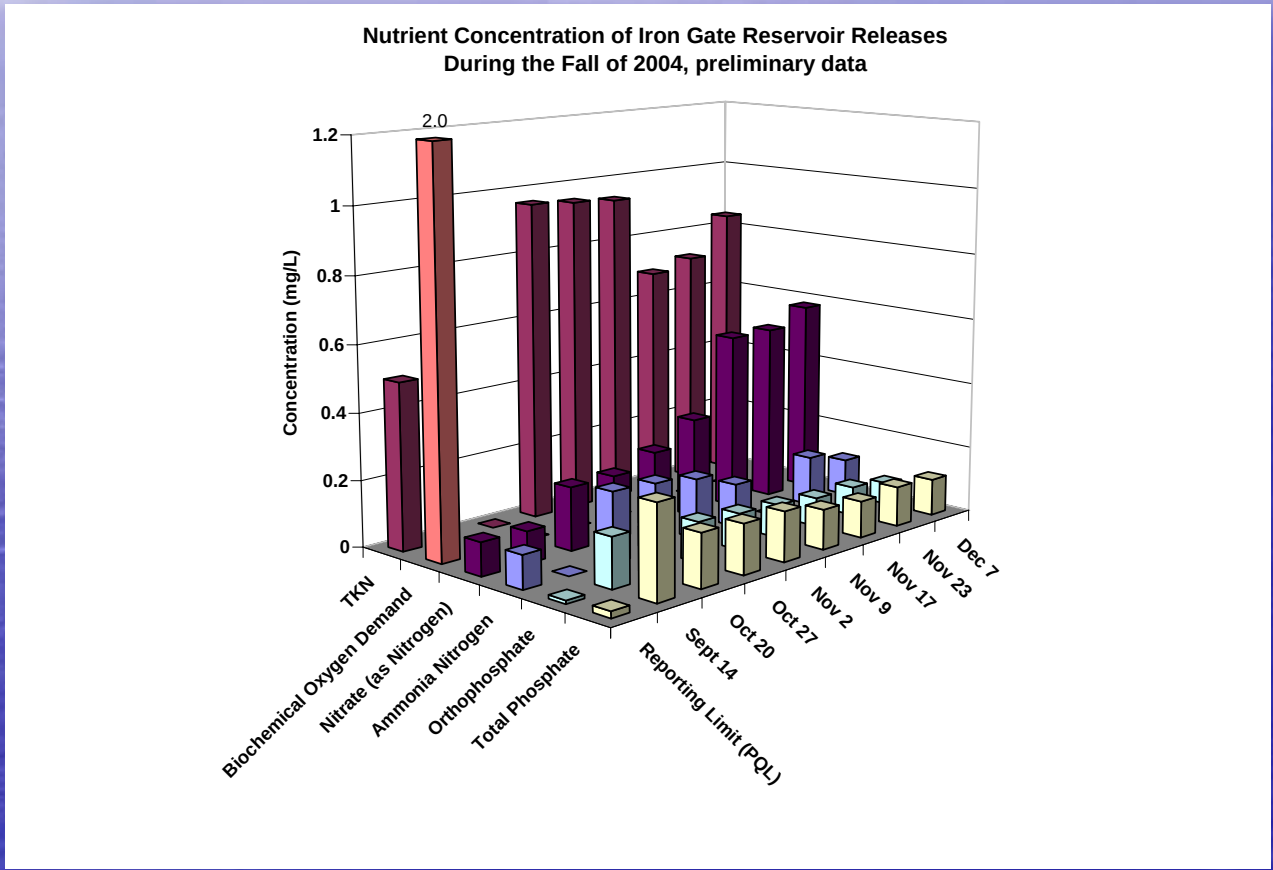
Vertical Profile of Dissolved Oxygen at Site 6, Fall 2004



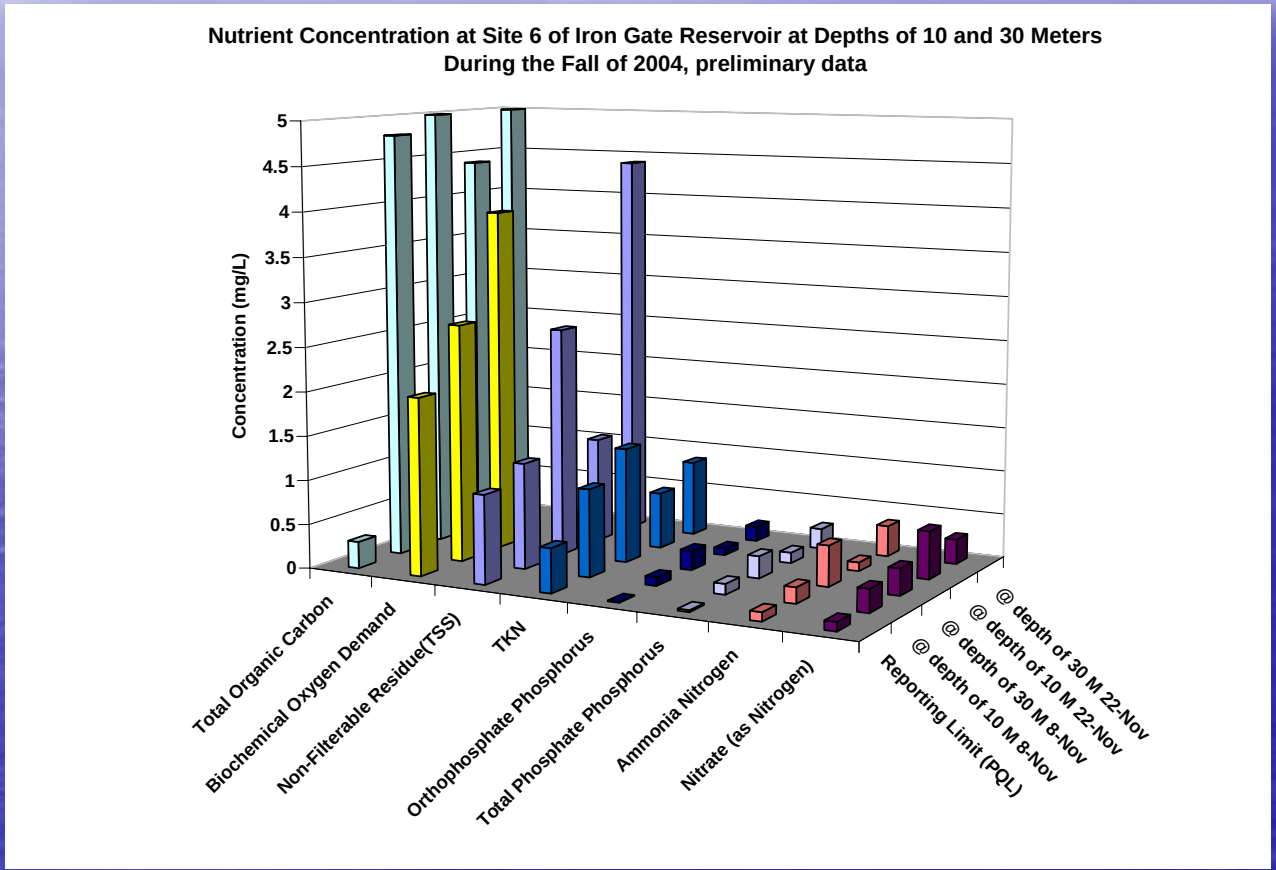
Nutrient Concentration below Copco II, Fall 2004



Nutrient Concentration at Iron Gate Hatchery Bridge, Fall 2004



Nutrient Concentration at Site 6 of Iron Gate Reservoir at Depths of 10 and 30 Meters, Fall 2004



Results and Discussion

- Without data from PacifiCorp temperature probes within the reservoir, cannot definitively define timing of turnover

- Profiles suggest that as of November 8th, hypolimnion was near a level of 80-90’ in depth, two weeks later it receded to near 100’ in depth.

Results and Discussion- cont.

- Nutrient levels within the hypolimnion were generally higher than within the epilimnion
  - BOD, TSS, TKN, phosphate and ammonia
- Some parameters decreased during the second sample (TKN and ammonia) while others increased (TSS and nitrate)

Results and Discussion- cont.

- Water temperature slowly declined at all sites, no drastic changes implying a rapid turnover.
- DO levels increased most at C2, possibly as a result of Copco Reservoir turning over earlier
- pH decreased almost a full unit at IG in the three weeks prior to the study.
  - Changes in reservoir water quality?
- Diurnal pH variation at K1 went from >1 pH unit to < 0.5 units by the end of the study possibly due to a reduction in primary productivity

Ammonia

- Ammonia present at all sites during all sample events.
  - Normally non-detect at Iron Gate during traditional sampling period of June through September
  - Why is it present now?
- Is this a product of an upstream turnover in C2 or other reasons?
- Not acutely toxic at this temperature and pH but what are the sub lethal effects on downstream spawners and redds?
- Additional monitoring for this and other parameters needs to happen later in the season to fully understand seasonal nutrient cycling and its effects on the Klamath River

Future Studies

- Future studies must rely on collection of data before, during and after the turnover event
  - Do convection currents through the reservoir following a turnover cause higher nutrient levels to occur within the surface water and downstream reaches?
  - If this is so, sampling needs to be continued past the actual turnover occurrence

Future Studies

- Simultaneous study of Copco Reservoir and upstream reaches also needed
- Profiles and grab samples should happen during the summer and early fall to better track the changes to the hypolimnion
  - should be integrated with other reservoir work such as algal speciation, abundance, etc.


THE END